



International Journal of Medical and Exercise Science

(Multidisciplinary, Peer Reviewed and Indexed Journal)

ORIGINAL ARTICLE

PAIN AND ASSOCIATED FUNCTIONAL LIMITATIONS OF WRIST AMONG STUDENTS USING SMARTPHONE- A CROSS-SECTIONAL STUDY

Search engine:
www.ijmaes.org

Jomi John¹, Ganga.S.Govind², Anjitha.P.P.³

Author:

¹Jomi John, Assistant Professor, CPAS School of Medical Education, Gandhinagar, Kottayam, Kerala, India. Email Id: jomijohn333@gmail.com

Co-Author:

³Anjitha P.P, BPT Student, CPAS School Of Medical Education, Gandhinagar, Kottayam, Kerala, India. Email Id: anjithaammu65@gmail.com

Corresponding Author:

²Ganga S Govind, BPT Student, CPAS School Of Medical Education, Gandhinagar, Kottayam, Kerala, India. Email Id: 99gsg9@gmail.com

ABSTRACT

Background of Study: Smartphones become an indispensable part of human life. In the past decade, there is an increase in the number of smartphone users. Many studies reveals that, smartphone overuse may cause many musculoskeletal problems mainly on neck, shoulder, wrist, hand, upper back region etc. The purpose of the study was to find out the pain and associated functional limitations of the wrist due to smartphone use among students. **Methods:** A cross-sectional survey was conducted among students of different colleges around Kerala in July 2021. Data was collected through self-structured questionnaire and were sent to students as Google forms with informed consent attached to it. Out of 671 samples only 532 were following the inclusion criteria and were selected for the study through convenient sampling. Patient-Rated Wrist Evaluation scale was used to assess the pain and disability of the wrist joint. **Results:** The data analysis shows that, 58.08% subjects have mild pain, 18.6% students have moderate pain and 6.2% students have severe pain due to smartphone use. **Conclusion:** The study concluded that there is a significant association between smartphone use with pain and functional disability experienced by the students in their wrist joint.

Keywords: Cross-sectional survey; functional limitation; smartphone; students; wrist pain

Received on 26th April 2022, Revised on 24th May 2022, Accepted on 27th May 2022
DOI:10.36678/IJMAES.2022.V08I02.002

INTRODUCTION

Smartphones are one of the most popular gadgets being used around the world¹. This little device has changed the way of communication among people and become an essential part in our everyday life². In the past decade, there is an increase in the number of smartphone users, frequency of their use and duration of the use^{3,4}. The smartphone has combined features of normal mobile phones and other personal digital assistant functions including Internet browsing, GPS navigation, voice recognition, touch screen, large display, accessing e-mails, third-party application known as 'apps', motion sensor, capturing high quality photographs and desktop synchronization^{5,6}.

Now-a-days people are spending most of their time in using smartphone and ignoring other aspects of life⁷. At present, most of the people from all age group owns atleast one type of mobile phone⁸. A study reported that about 79% of people from 18-44 years of age have their smartphone with them all the time and they spent nearly 2 hours for walking without smartphones in their hand¹.

The innovations in technologies have changed the traditional way of education. Currently, the COVID-19 pandemic has changed our lives, especially in economy and educational sector. The pandemic had force the educational institutions to stop taking offline classes and lectures for the safety of students⁹. To ensure integrity and continuity of education process, the institutions have been implementing a general shift from traditional face-to-face teaching method/black board method to digital platforms^{9,10}. Most commonly proposed method was video conference with interactive discussions. These changes in the educational

system increase the number of smartphone users and its use among students¹¹.

The main uses of smartphone are chatting, tweeting, social media interactions, communication, formatting documents and other activities². These activities may lead to various musculoskeletal problems as they engaged in the same position for a long period of time repeatedly without making any specific movements¹. Due to the sudden exertion or prolonged, forceful, low amplitude and repetitive use of mobile phones may lead to an increase in musculoskeletal disorders of neck, arm, forearm, wrist and hand across the World^{1,2}. Incorrect posture and wrong way of holding mobile phones are major causes of chronic musculoskeletal pain¹.

Smartphone overuse may decrease the handgrip strength and hand function of their dominant hand. Increased usage causes weakness in hand and wrist due to repeated movements of them, which in turn leads to many musculoskeletal disorders. The commonly reported musculoskeletal disorders are De Quervain's tenosynovitis, Carpal Tunnel Syndrome, Myofascial Syndrome in hand, symptoms of fibromyalgia, SMS thumb, Carpo-metacarpal joint arthritis, tendinitis in extensor pollicis longus and adductor pollicis, wrist tendonitis etc. Few studies also reveals that, some users experiences numbness, tingling and burning sensation around the thenar eminence of the hand^{1,2,5,12,13,14}.

With the advancement in technologies, smartphone has become the most popular gadget bought by the people worldwide. This makes our lifestyle more easeful and comfortable. Regardless of the advantages of smartphone like communication, social networking, gaming etc. it impacted the human

lives adversely^{13,15}. Young population holds the majority of the smartphone consumers due to its wide application. They spend more time on smartphone and other devices rather than playing outside and interacting with the people^{16,17}.

The rapid and extensive use of smartphone may affect the quality of life of the users¹³. The increased use may cause many physical, psychological and social issues. The major musculoskeletal problems reported by the smartphone users are neck pain, back pain, wrist and thumb pain. Majority of the musculoskeletal problems are due to improper posture and increased duration of use. Several studies show that most of the smartphone users experiences wrist pain which may interfere with their phone use^{13,17}.

Therefore, the aim of this study was to investigate the intensity of wrist pain and associated functional limitations among the students using smartphones and its impact in their quality of life.

METHODOLOGY

The study design was Cross-sectional study. The study was carried out in July 2021. Participants were recruited from recognized colleges in Kerala. Total 532 samples were selected for this study.

Inclusion criteria: Both male and female subjects aged between 18-25 included in this study. Also, the selecting subjects should be students who use smartphone >1 hour continuously and currently studies in Kerala.

Exclusion criteria: Subjects with history of hand surgery, fracture of wrist, Recent accident or trauma of wrist, Recent history of taking analgesics, Liver disease, Carpal Tunnel

Syndrome, Neurological deficits, Inflammatory arthropathy and Diabetes were excluded from the study.

Procedure: The prepared Google forms were sent to students via WhatsApp and e-mails. It was sent to about 700 people. From that 671 were agreed to participate in this study and filled out the form. Out of 671 samples, only 532 were favoring the inclusion criteria. Studies suggest that larger sample size may provide better results. Thus, the sample size was estimated to as 532. The structured questionnaire contains Demographic data, Patient-Rated Wrist Evaluation Scale (PRWE)¹⁸, Cornell Mobile Phone Hand Discomfort Questionnaire (CHDQ)¹⁹ and some selected questions from Smartphone Addiction Scale-Short Version(SAS-SV)²⁰.

Demographics: Other than common demographic data (name, age, gender, place, contact and educational details) some other questions were also added to the questionnaire like duration of phone usage (continuously and throughout day), mode of online class, preferred position for attending classes and also the purpose of smartphone usage other than calling and text messaging, including:(i) Social Networking (ii) Entertainment (iii) News (iv) Games (v) Online Class and (vi) Research and Homework.

Patient-Rated Wrist Evaluation Scale (PRWE): The pain and disability was assessed through Patient-Rated Wrist Evaluation questionnaire (PRWE). PRWE is a 15-item questionnaire designed to measure pain and disability at wrist joint. It allows patients to rate their wrist pain and disability levels from 0 to 10, and consists of 2 subscales; pain subscale and function subscale. Pain subscale contains 5 items. Function subscale is further divided into 2

sections i.e. specific activities (having 6 items) and usual activities (having 4 items). The maximum score of each subscale is 50 and minimum is 0. Test-retest reliability of PRWE was found excellent¹⁸.

Cornell Mobile Phone Hand Discomfort Questionnaire (CHDQ): The CHDQ is a six-item questionnaire with a hand map diagram of six shaded areas of the hand that contains questions regarding the prevalence of musculoskeletal pain, discomfort, and interference with work. The questionnaire was filled in by the participants based on their dominant hand. This scale provides an information about which part of the hand is most impaired^{12,19}.

Smartphone Addiction Scale-Short Version (SAS-SV): Some of the questions asked were taken from Smartphone Addiction Scale short version (SAS-SV). Smartphone addiction was assessed using the SAS-SV. This is the short version of the scale developed by Kwon et al; with internal consistency and concurrent validity. This is 10-item self-report instrument with 6 points Likert scale. SAS-SV address the following areas, daily life disturbance, withdrawal, cyberspace oriented relationship, overuse, and tolerance. It has good validity and reliability for the assessment of smartphone addiction^{1,20}.

Outcome measures

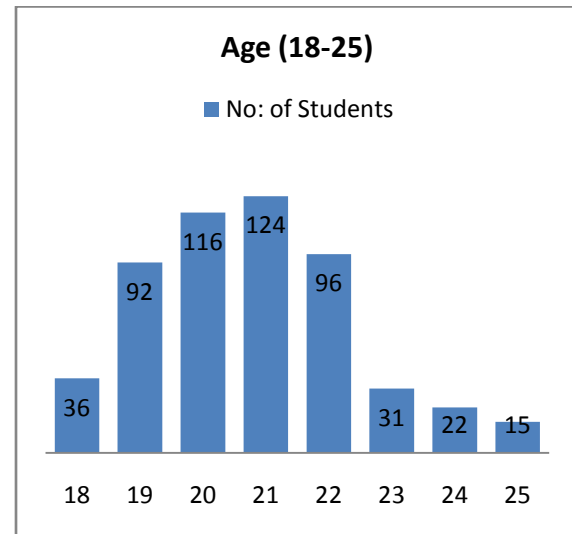
- Patient-Rated Wrist Evaluation Scale (PRWE)
- Cornell Mobile Phone Hand Discomfort Questionnaire (CHDQ)

RESULTS

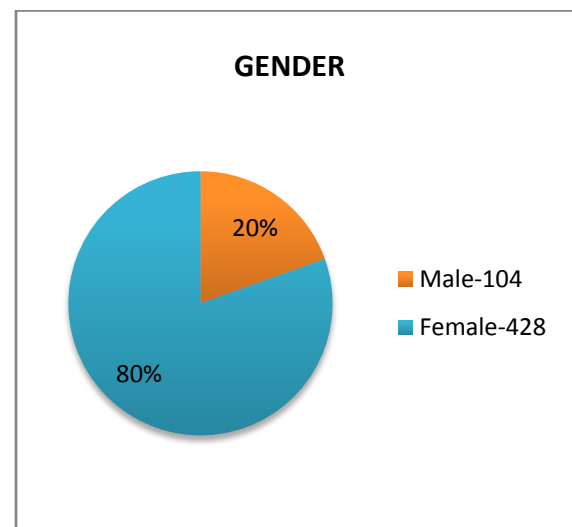
A total of 532 participants were included in this study from the collected data containing 671 samples. The participation rate was 78.81%

(532/675), 4 of them were disagreed to participate and 139 samples were excluded from the study and 532 were analyzed for the final results. From the data obtained, there was a female predominance.

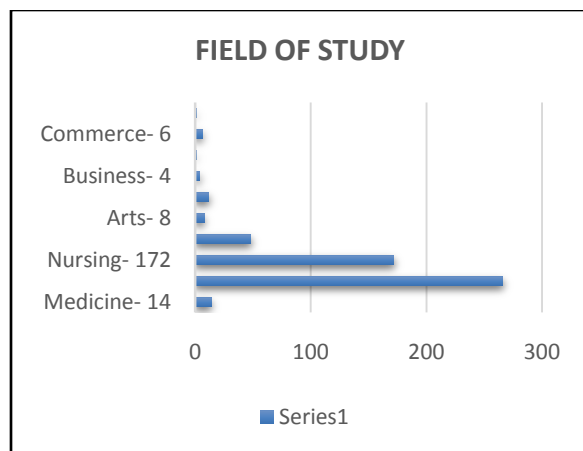
Demographical Details:



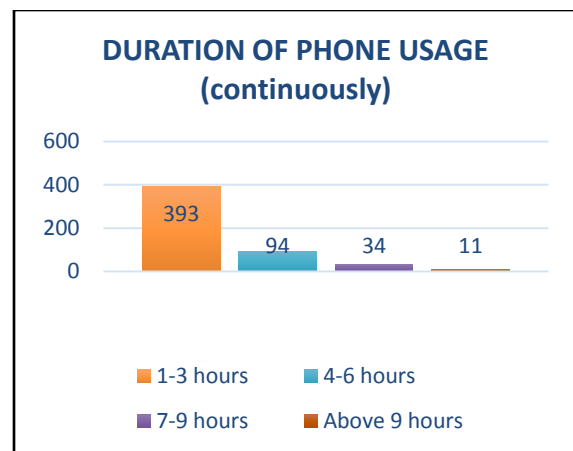
Graph 1 : Graphical representation of age



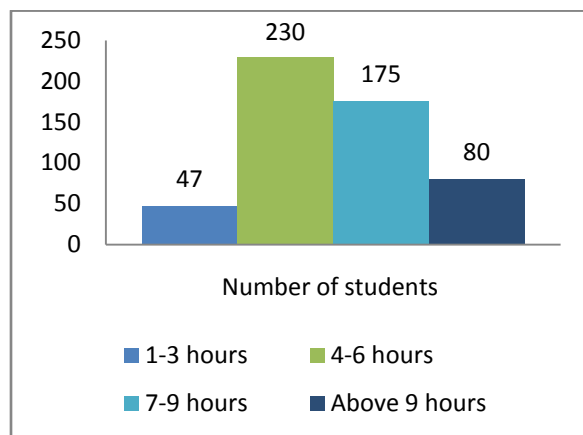
Graph 2 :Graphical representation of gender



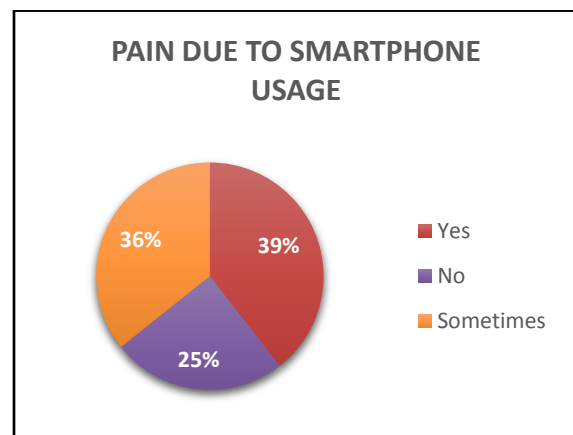
Graph 3: Graphical representation of field of study



Graph 5: Graphical representation of duration of phone usage (continuously)



Graph 4 : Graphical representation of smartphone usage in a day



Graph 6: Graphical representation of pain due to smartphone usage

Testing Association Using Chi- Square test

1) Association Between Pain And Phone use

| Variable | | Pain Score | | | | Total | Chi-Square | P Value |
|-----------|---------------|------------|-----|----|----|-------|------------|--------------|
| | | 0 | 1 | 2 | 3 | | | |
| Phone Use | 1-3 Hours | 6 | 31 | 6 | 4 | 47 | 18.39 | 0.031 (Sig.) |
| | 4-6 Hours | 45 | 134 | 44 | 7 | 230 | | |
| | 7-9 Hours | 34 | 99 | 30 | 12 | 175 | | |
| | Above 9 Hours | 6 | 45 | 19 | 10 | 80 | | |
| Total | | 91 | 309 | 99 | 33 | 532 | | |

Table1- Distribution and Chi-Square Test of The Association Between Times of Smartphone Use and Pain.

Conclusion: Table 1 shows the distribution and Chi-square test of the association between time of smartphone use and wrist pain. The intensity of pain recorded from 0 to 10 were grouped as 0, 1(1-3), 2(3-6) and 3(6-10). The class 0 indicates no difficulty, 1-mild pain, 2-moderate pain and 3- severe pain. Here, the

calculated value of Chi-square test is 18.39 and the corresponding P value is 0.031, which is less than 0.05. So, we reject the null hypothesis, i.e. there is a significant association between smartphone use and pain (how often do you have pain).

2) Association Between Function And Phone Use

| | | Function Score | | | | Total | Chi-Square | P Value |
|-----------|---|----------------|-----|-----|----|-------|------------|----------------|
| | | 0 | 1 | 2 | 3 | | | |
| Phone Use | 1 | 9 | 24 | 13 | 1 | 47 | 17.64 | 0.04 (Sig.) |
| | 2 | 51 | 145 | 31 | 3 | 230 | | |
| | 3 | 45 | 108 | 18 | 4 | 175 | | |
| | 4 | 10 | 53 | 13 | 4 | 80 | | |
| Total | | 91 | 213 | 199 | 29 | 532 | | |

Table 2- Distribution and Chi-Square Test of the association between time of smartphone use and functional activities

Conclusion: Table 2 shows the distribution and chi-square test of the association between time of Smartphone use and functional activities. The intensity of pain recorded from 0 to 10 were grouped as 0, 1(1-3), 2(3-6) and 3(6-10). The class 0 indicates no difficulty, 1-mild pain,

2- moderate pain and 3- severe pain. Here, the calculated Chi-square value is 17.64 and the corresponding P value is 0.04, which is less than 0.05. So, we reject the null hypothesis. That is, there is a significant association between smartphone use and functional activities.

Testing Association Using Anova Test

3) Usual Activity and Phone Use

| Phone use | N | Mean | Standard Deviation |
|-----------|-----|------|--------------------|
| 1-3 | 47 | 7.83 | 8.47 |
| 4-6 | 230 | 5.87 | 7.11 |
| 7-9 | 175 | 6.10 | 7.74 |
| 9 Above | 80 | 8.65 | 9.27 |
| Total | 532 | 6.54 | 7.84 |

Table3: Descriptive Table (based on total score of usual activity)

| | Sum of Squares | df | F Value | P Value |
|-----------------------|----------------|-----|---------|------------|
| Between Groups | 1117.5 | 3 | 5.12 | 0.002(Sig) |
| Within Groups | 38414.61 | 529 | | |
| Total | 39532.11 | 532 | | |

Table 4: ANOVA table For usual activity and smartphone use

Null Hypothesis; Ho: there is no significant difference between the variance of Total Pain based on smartphone use.

Conclusion: Table 4 shows the ANOVA test for usual activities and smartphone use. Here P Value is less than 0.05. So, we reject the null hypothesis. That is there is a significant differ-

ence between the variance of usual activity based on smartphone use.

This can also be proved using F value. The calculated value is $f(3,528)=5.12$ and the P value is 0.002 which is less than 0.05. So, we reject the null hypothesis and accept the alternative hypothesis i.e. there is a significant association between functional limitations and smartphone usage.

4) Phone use and Total Pain

| Phone use | N | Mean | Standard Deviation |
|----------------|-----|-------|--------------------|
| 1-3 | 47 | 11.53 | 9.04 |
| 4-6 | 230 | 10.33 | 7.89 |
| 7-9 | 175 | 11.29 | 8.85 |
| 9 Above | 80 | 14.66 | 9.26 |
| Total | 532 | 11.4 | 8.63 |

Table 5: Descriptive Table (based on total Pain)

| | Sum of Squares | df | F Value | P Value |
|-----------------------|----------------|-----|---------|------------|
| Between Groups | 572.51 | 3 | 3.14 | 0.025(Sig) |
| Within Groups | 32069.8 | 529 | | |
| Total | 32642.3 | 532 | | |

Table 6: ANOVA table For Phone Use and Total pain

Null Hypothesis, Ho: there is no significant difference between the variance of Total Pain based on smartphone use.

Conclusion: Table 6 shows the results of ANOVA test for phone use and total pain. Here P Value is less than 0.05. So, we reject the null hypothesis. That is there is a significant

difference between the variance of Total Pain based on smartphone use.

This can also be proved using F value. The calculated value is $f(3,528)=3.14$ and the P value is 0.025 which is less than 0.05. So, we reject the null hypothesis and accept the alternative hypothesis i.e. there is a significant association between smartphone usage and total pain.

| | | A | B | C | D | E | F |
|--------------|---------------------------------|------------|------------|------------|------------|------------|------------|
| Que.1 | NEVER | 295 | 334 | 278 | 358 | 316 | 375 |
| | 1-2 | 114 | 106 | 130 | 100 | 124 | 98 |
| | 3-4 | 29 | 27 | 40 | 20 | 24 | 17 |
| | Once a week | 69 | 44 | 61 | 43 | 52 | 32 |
| | Several | 25 | 21 | 23 | 11 | 16 | 10 |
| | Total | 532 | 532 | 532 | 532 | 532 | 532 |
| Que.2 | Not applicable | 243 | 285 | 238 | 310 | 276 | 326 |
| | Slightly uncomfortable | 230 | 188 | 216 | 163 | 177 | 147 |
| | Moderately uncomfortable | 45 | 46 | 65 | 48 | 64 | 48 |
| | Very uncomfortable | 14 | 13 | 13 | 11 | 15 | 11 |
| | Total | 532 | 532 | 532 | 532 | 532 | 532 |

| | | | | | | | |
|--------------|---------------------------------|------------|------------|------------|------------|------------|------------|
| Que.3 | Not applicable | 185 | 211 | 172 | 236 | 214 | 245 |
| | Not at all | 170 | 174 | 169 | 141 | 153 | 152 |
| | Slightly interfered | 164 | 132 | 170 | 138 | 142 | 122 |
| | Substantially interfered | 13 | 15 | 21 | 17 | 23 | 13 |
| | Total | 532 | 532 | 532 | 532 | 532 | 532 |

Table 7: Frequency Distribution of Section 3

Conclusion: A, B, C, D, E, F represents the wrist and different parts of the hand. Here, A indicates index, middle and lateral aspect of 4th finger, B-medial aspect of 4th finger and little finger, C-thumb, D- palm, E- thenar eminence and F-wrist. From the data, it is clearly indicated that 4.6% of them i.e. 24 students reported severe pain in index finger, middle finger and 4th (ring) finger while using mobile phone. In this, 13 students have slight discomfort due to pain, 4 of them have moderate discomfort and 7 students were felt very uncomfortable due to the pain. Among this, 5 students reported that this pain doesn't interfere with their phone usage, a slight interference have reported by 17 students and only 2 students have reported a higher interference of the pain with their phone usage.

DISCUSSION

This study was conducted to evaluate the relation between wrist pain and its associated functional limitations among students using smartphone. 532 students who satisfy the inclusion criteria were selected for the study. The age of the participants ranges from 18-25 years. The subjects selected were residents of Kerala. Subjects with recent accidents or trauma of wrist, hand surgery, fracture of wrist, recent history of taking analgesics, liver disease, carpal tunnel syndrome, neurological deficits, inflammatory arthropathy and

diabetes were excluded from the study. The data was collected through Google forms with informed consent attached to it. The participants were aware of the study and the fact that they can withdraw from the study at any time.

Pain and functional limitations of wrist were assessed using Patient-Rated Wrist Evaluation Scale (PRWE). It was scored by the students themselves. It consists of two subscales; pain and functions scale. This allows the subjects to rate their wrist pain and disability levels from 0 to 10. The outcome measures were analyzed by using Chi-square test and ANOVA test to interpret the results. Some questions were taken from Cornell Mobile Hand Discomfort Questionnaire (CHDQ) for getting information about which part of the hand is more involved and whether any discomfort while using smartphone.

The results of the present study shown that wrist pain is the common problem arising from smartphone users, thereby supporting the alternative hypothesis i.e. there is a significant relation between smart phone usage and wrist pain.

Mobile phones are one of the major communication devices. The number of mobile phone users increasing every year. According to statistics taken in 2016, the number of users was more than 7 billion and this count may

expect to rise in coming years. Recent studies show that, there is a rapid increase of smartphone use among students. Due to COVID-19 pandemic, the traditional way to teaching is not possible. With the advancement of technologies, face-to-face method has shifted to online platforms. While there are many advantages, smartphone have some demerits too. The prolonged use of smartphone can affect on the physical, mental and social life.

According to the results of the present study 58.26% subjects had mild pain over the wrist; it was found comparable to the previous study by Amjad et al.². They reported 48% of subjects with frequency of minimal (1-20) wrist pain and disability. However it was little higher than the findings of Ayman Baabdullah et al.⁵; they reported 20.4% of participants had pain over thumb/wrist. The pain due to smartphone usage may also cause several functional limitations on daily life. The result of the current study shows 63% of subjects with usage hours between 4 to 6 continuously had mild functional limitation.

In a study by Parasuraman et al.²¹, reported 26% frequency of wrist pain among smartphone users. Participants of the study were using smartphones for roughly less than one hour, whereas in the current study the majority of participants i.e. 43.23% of them have smartphone usage of more than 4 to 6 hours per day. The variations in the duration may due to the Covid-19 pandemic. In the recent years, smartphone use has been tremendously increased due to the social restrictions caused by Covid-19. The people tends to spend more time on social media and other platforms to escape from their loneliness and to maintain their social interactions via these digital platforms (Fernandes B et al)²².

Thus the results of the current study shows majority of the participants spend more than 4-6 hours per day on smartphone which was consistent with Amjad et al.²

In the current study, it is found that most of the participants are from the age group of 21 years having a frequency of 124. Majority of the participants i.e. 80.45% are females. From the results it is clear that, most of the participants have physical discomfort while using smartphone. They spent most of their time on smartphone other than online class (27.95%) are for entertainment purpose and social networking.

The objective of using PRWE in the study was to provide an assessment of wrist pain and its associated functional limitations. Chi-square Test and ANOVA Test were used to interpret the collected data.

Chi-square Test was used to get an account for the association between the wrist pain and functional activities with phone use. From the data, it is found that majority of the students i.e. 230 have using smart phone for 4-6 hours continuously in a day. The value of Chi-square test for pain and smartphone was 18.39 and having a P value of 0.031. So, the result shows that there is a significant association between Smartphone use and wrist pain. The value of Chi-square test for smart phone and functional activities is 17.64 and the P value is 0.04. Thereby, the result shows that there is a significant association between Smartphone use and functional activities.

Based on the statistical analysis, the ANOVA test mean value with Standard deviation of Usual Activity and Phone use was 6.54 ± 7.84 , degree of freedom between groups was 3 and within groups was 529, f value was 5.12 and

the p value is 0.002. Thus, result shows that there is a significant association between the functional limitations and smartphone use.

While the ANOVA test mean value with Standard Deviation of phone use and total pain was 11.4 ± 8.63 degree of freedom between groups was 3 and within groups was 529, f value was 3.14 and the p value is 0.025. The result shows that there is a significant association between smartphone use and total pain.

Smartphone usage can interfere in people's life in many aspects. Increased smartphone use may results in many musculoskeletal problems mainly on neck, shoulder, elbow, hand, wrist and upper back region. Mustafaoglu et al.¹ reported that prolonged smartphone use may allow the wrist to be in an inappropriate posture for a period of time and cause weakness to the hand and the wrist. Another study by Inal et al.²³ reported that in strong smartphone users, the repetitive and extensive wrist flexion and extension movements during smartphone use can affect the median nerve and may lead to Carpal Tunnel Syndrome. The study also reported that placing the thumb and the wrist in static posture will probably cause an increased load to these joints, muscles, tendons and associated structures. Although, the results of the present study is similar to the results of Amjad et al.², increased smartphone use can induce wrist pain and this pain can leads to functional limitations on their daily life activities.

It will be more accurate if the study was conduct in direct contact with the subjects rather than by Google Forms. Increasing the sample size and age criteria i.e., below 18 years and above 25 years can be attempted. Participants were University students with a

slight bias towards female students and do not represent the total population of the university students. Therefore, the results cannot be generalized to other population. It was found to be difficult for students to fill out the lengthy questionnaire and hence it affects the quality of data and also the results. The study setting can be extended i.e. participants from outside Kerala can also be included. Questions regarding the holding position of smart phone and the screen size in the questionnaire can bring more accurate results.

Further studies can be done with more sample size, increasing the age criteria i.e. below 18 years and above 25 years and extending the study setting to outside Kerala. Can include questions related to position for holding the mobile phone and screen size in the survey questionnaire can be attempted. Bringing equality in the male and female ratio can fetch more accuracy. Data can be collected by direct method instead of Google Forms. Decreasing the span of the questionnaire can also be attempted.

Ethical clearance: Ethical clearance has obtained from CPAS School of Medical Education, Gandhinagar, Kottayam, Kerala with reference number BPTPA/EC/SMEGMR/2021/01 dated on 30/06/2021.

Conflict of interest: There was no conflict of interest to conduct this study.

Fund for the study: It was a self financed study.

CONCLUSION

The result of the study shows that the smartphone users experience pain and functional limitations in the wrist joint due to overuse.

Based on the statistical analysis, mean value with Standard Deviation of usual activity with smartphone use 6.54 ± 7.84 and mean value with Standard deviation of phone use with total pain was 11.4 ± 8.63 . The results of the study shows that there is a significant association between smartphone use with pain and function of the wrist joint.

Also, the result shows that there is a statistically significant difference between the variance of smartphone use with usual activity and pain.

After analyzing the study, it can be concluded that increased duration of smartphone usage may lead to pain and functional disability of the wrist joint. Therefore, the study rejects the null hypothesis and accepts the alternate hypothesis.

REFERENCE

1. Mustafaoglu R, Yasaci Z, Zirek E, Griffiths MD, Ozdinciler AR. The relationship between smartphone addiction and musculoskeletal pain prevalence among young population: A cross-sectional study. *The Korean Journal of Pain*. 2021; 34(1);72-81.
2. Amjad F, Farooq M, Batool R, Irshad A. Frequency of wrist pain and its associated risk factors in students using mobile phones. *Pakistan Journal of Medical Sciences*. 2020;36(4).
3. Eitivipart AC, Viriyarajanukul S, Redhead L. Musculoskeletal disorder and pain associated with smartphone use: A systematic review of biomechanical evidence. *Hong Kong Physiotherapy J*. 2018;38(2);77–90.
4. Goggin G. Cell phone culture: Mobile technology in everyday life. New York: Routledge, 2012.
5. Baabdullah A, Bokhary D, Kabli Y, Saggaf O, Daiwali M, Hamdi A. The association between smartphone addiction and thumb/wrist pain :A cross-sectional study. *Medicine* 2020; 99; 10(e19124).
6. Choi JS, Yi B, Park JH, et al. The uses of the smartphone for doctors: an empirical study from Samsung Medical Center. *Health Inform Res* 2011;17;131–8.
7. Ammati R, Kakunje A, Karkal R, Nafisa D, Kini G, Chandrashekar P. Smartphone Addiction among Students of Medical University in South India: A Cross-Sectional Study. *Annals of International Medical and Dental Research*. 2018; 4(2); 21276.
8. Xie Y, Szeto G, Dai J. Prevalence and risk factors associated with musculoskeletal complaints among users of mobile handheld devices: A systematic review. *Applied Ergonomics*. 2017;59(PtA);132-42.
9. Rajab MH, Gazal AM, Alkattan K. Challenges to online medical education during the COVID-19 pandemic. *Cureus*. 2020;12(7); e8966.
10. Bringman-Rodenbarger L, Hortsch M. How students choose E-learning resources: The importance of ease, familiarity, and convenience. *FASEB BioAdvances*. 2020; 2(5); 286–95.
11. Alsoufi A, Alsuyihili A, Msherghi A, Elhadi A, Atiyah H, Ashini A, et al. Impact of the COVID-19 pandemic on medical education: Medical students' knowledge, attitudes, and practices regarding electronic learning. *PLoS One*. 2020;15 (11); e0242905.
12. Ahmed S, Akter R, Pokhrel N, Samuel A. Prevalence of text neck syndrome and SMS thumb among smartphone users in college-going students: a cross-sectional survey

- study. Journal of Public Health. 2019;29(2);411-416.
13. Bhamra JK, Naqvi WM, Arora SP. Effect of smartphone on hand performance and strength in the healthy population. Cureus [Internet]. 2021;13(6);e15798.
 14. Zirek E, Mustafaoglu R, Yasaci Z, Griffiths MD. A systematic review of musculoskeletal complaints, symptoms, and pathologies related to mobile phone usage. Musculoskeletal SciPract 2020; 49; 102196.
 15. Chen B, Liu F, Ding S, Ying X, Wang L, Wen Y. Gender differences in factors associated with smartphone addiction: a cross-sectional study among medical college students. BMC Psychiatry [Internet]. 2017;17(1); 341.
 16. Singh MKK, Samah NA. Impact of smartphone: A review on positive and negative effects on students. Asian Soc.Sci [Internet]. 2018;14(11); 83.
 17. Woo EHC, White P, Lai CWK. Musculoskeletal impact of the use of various types of electronic devices on university students in Hong Kong: An evaluation by means of self-reported questionnaire. Man Ther. 2016;26; 47-53.
 18. Mehta SP, MacDermid JC, Richardson J, MacIntyre NJ, Grewal R. A systematic review of the measurement properties of the patient-rated wrist evaluation. J Orthop Sports PhysTher [Internet]. 2015;45(4);289–98.
 19. Erdinc O, Hot K, Ozkaya M. Turkish version of the Cornell Musculoskeletal Discomfort Questionnaire: cross-cultural adaptation and validation. Work [Internet]. 2011; 39(3);251-60.
 20. Kwon M, Kim D-J, Cho H, Yang S. The smartphone addiction scale: development and validation of a short version for adolescents. PLoS One [Internet]. 2013; 8(12); e83558.
 21. Parasuraman S, Sam A, Yee SK, Chuon BC, Ren L. Smartphone usage and increased risk of mobile phone addiction: A concurrent study. Int J PharmInvestig [Internet]. 2017;7(3);125.
 22. Fernandes B, Biswas UN, Tan-Mansukhani R, Vallejo A, Essau CA. The impact of COVID-19 lockdown on internet use and escapism in adolescents. Rev psicolclín con niñosadolesc [Internet]. 2020;7(3); 59-65.
 23. İnal EE, Demirci K, Çetintürk A, Akgönül M, Savaş S. Effects of smartphone overuse on hand function, pinch strength, and the median nerve: Smartphone Overuse. Muscle Nerve [Internet] 2015;52(2);183-8.

Citation:

Jomi John, Ganga S Govind, Anjitha P P(2022). Pain and Associated Functional Limitations of Wrist among Students using Smart Phone-A Cross Sectional Study, *ijmaes*; 8 (2); 1248-1260.